SOLUTIONS

PHASE TEST-2

GRA

JEE MAIN PATTERN

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PHYSICS

1. (B)

$$\frac{\Delta T}{T}\times 100 = \frac{\frac{1}{5}}{25}\times 100 = 0.8\%\cdot$$

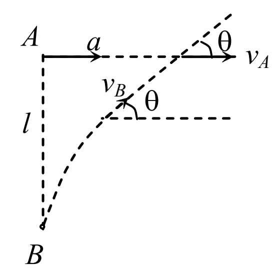
2. (D)

$\frac{d|\vec{v}|}{dt}$ is the tangential acceleration.

3. (A)

Let after time *t*, the velocity of particle *B* is directed at an angle θ with the horizontal, then

$$-\frac{ds}{dt} = bt - at\cos\theta$$



$$\Rightarrow \quad -\int_l^0 ds = b\int_0^t t\,dt - a\int_0^t t\cos\theta\, dt$$

and $\frac{1}{2}at^2 = b\int_0^t t\cos\theta\, dt \qquad \therefore\ l = \frac{bt^2}{2} - \frac{a^2t^2}{2b}$

$$t = \sqrt{\frac{2bl}{b^2-a^2}}, \qquad S = \frac{1}{2}bt^2 = \frac{1}{2}b\frac{2bl}{b^2-a^2} = \frac{b^2 l}{b^2-a^2}.$$

4. (B)

Let 1: Block, 2: Platform

$$\vec{u}_{12} = \vec{u}_1 - \vec{u}_2 = 3\hat{i} - 4\hat{j}$$

$$\vec{u}_{12} = \vec{a}_1 - \vec{a}_2 = -\frac{3}{5}\left(3\hat{i} - 4\hat{j}\right)$$

$$\therefore \quad t_0 = \frac{5}{3}\text{sec}, \ \vec{s}_{12} = \frac{25}{6}\left(\frac{3\hat{i} - 4\hat{j}}{5}\right)\text{m}$$

$$\therefore \quad \vec{s}_k = \frac{5}{6}\left(3\hat{i} - 4\hat{j}\right) + \frac{20}{3}\hat{j}$$

$$= \frac{5}{6}\left(3\hat{i} + 4\hat{j}\right) + \frac{20}{3}\hat{j}$$

$$\therefore \quad \vec{s}_k = \frac{25}{6}\text{m}.$$

5. (B)

Acceleration of block *m* with respect to inclined plane = 6

$\therefore$ Acceleration of incline plane $a_2 = \frac{m}{m+2m} \times 6\sin 60° = \sqrt{3}\, m/s^2$.

6. (B)

Let the particle leaves the vertical circular motion at an angle ϕ with the upward vertical.

Then critical velocity at angle ϕ is given by

$$v_C = \sqrt{gl\cos\phi}$$

$$\therefore \; l + l\cos\phi + \frac{gl\cos\phi\sin^2\phi}{2g} = \frac{27l}{16}$$

$$1 + \cos\phi + \frac{\cos\phi(1-\cos^2\phi)}{2} = \frac{27}{16}$$

$$2 + 2\cos\phi + \cos\phi - \cos^3\phi = \frac{27}{8}$$

$$\cos^3\phi - 3\cos\phi + \frac{11}{8} = 0 \Rightarrow \cos\phi = \frac{1}{2} \quad \text{or} \quad \phi = 60°.$$

$$v_C = \sqrt{\frac{gl}{2}}.$$

7. (A)

$$\frac{1}{2}k\left(\frac{h}{4}\right)^2 = mg\left(h + \frac{h}{4}\right), \qquad k = \frac{32mg}{h}\left(\frac{5}{4}\right) = \frac{40mg}{h}.$$

8. (D)

Momentum of the shell at highest point = $2m(u\cos\theta)$. As one fragment has initial speed zero (stationary) and hence the other fragment of mass m has velocity component ($2u\cos\theta$) in horizontal direction. This will move under gravity, So, it will fall at a distance which is equal to

$$\left(\frac{u\sin\theta}{g}\right)(2u\cos\theta) = \frac{u^2\sin 2\theta}{g} = R$$

Hence, distance covered from the gun $= \frac{R}{2} + R = \frac{3}{2}R = \frac{3}{2}\left[\frac{u^2\sin 2\theta}{g}\right]$.

9. (B)

From Newton's third law, force *F* will act on the block in forward direction

Acceleration of block $a_1 = \frac{F}{M}$

retardation of bullet $a_2 = \frac{F}{m}$

relative retardation of bullet

$$a_r = a_1 + a_2 = \frac{F(M+m)}{Mm}$$

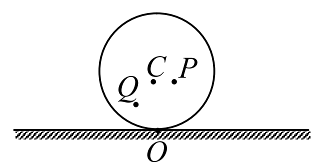
Applying $v^2 = u^2 - 2a_r l$

$$0 = v_0^2 - \frac{2F(M+m)}{Mm}.l \quad \text{or} \quad v_0 = \sqrt{\frac{2Fl(M+m)}{Mm}}$$

Therefore, minimum value of v_0 is

$$\sqrt{\frac{2Fl(M+m)}{Mm}}.$$

10. (B)



$OP > OC > OQ$

$\therefore V_P > V_C > V_Q$

11. (C)

$$I_1\omega_1 = I_2\omega_2$$

$$\Rightarrow MK_1^2\omega_1 = MK_2^2\omega_2 \Rightarrow \frac{K_1}{K_2} = \sqrt{\frac{\omega_2}{\omega_1}}.$$

12. (C)

Clearly, the block shall topple about its edge through *O*. The torque FL of the applied force is clockwise. The torque $\frac{mgL}{2}$ of the weight is anti-clockwise. Applying condition for rotational equilibrium $-FL + mg\frac{L}{2} = 0$ or $F = \frac{mg}{2}$.

13. (B)

According to law of conservation of energy

$$\frac{1}{2}mv^2\left(1+\frac{k^2}{R^2}\right) = Mgh \text{ or } h = \frac{3v^2}{4g}.$$

14. (B)

$$y = 0.2\left(\cos^2\frac{\pi t}{2} - \sin^2\frac{\pi t}{2}\right)$$

$$y = 0.2\cos\pi t$$

$$\therefore \quad A = 0.2,\ T = \frac{2\pi}{\pi} = 2\,\text{s}.$$

15. (C)

$$F_R = Ma = -(kx + A\sigma g x);\ \omega = \sqrt{\frac{k + A\sigma g}{M}};\ T = 2\pi\sqrt{\frac{M}{k + A\sigma g}}.$$

16. (A)

17. (D)

$$\frac{E_A}{E_B} = \frac{r_B}{r_A} = \frac{2}{1}.$$

18. (A)

Total energy = – kinetic energy = -*E*

So energy *E* should be supplied.

19. (D)

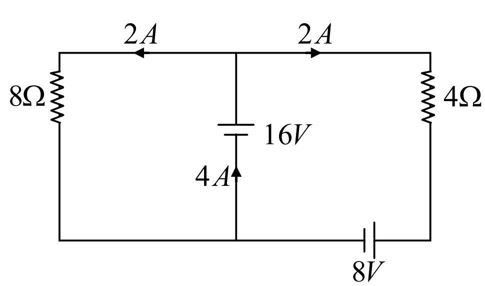
The maximum length of the string which can fit into the cube is $\sqrt{3}a$, equal to its body diagonal. The maximum charge inside the cube is $\sqrt{3}a\lambda$, and hence the maximum flux through the cube is $\frac{\sqrt{3}\lambda a}{\varepsilon_0}$

20. (C)

tan 30° = $\frac{1}{2}\tan\theta$, tan q = $\frac{2}{\sqrt{3}}$.

21. (B)

The simplified circuit can be drawn as



$I_1 = 4A$

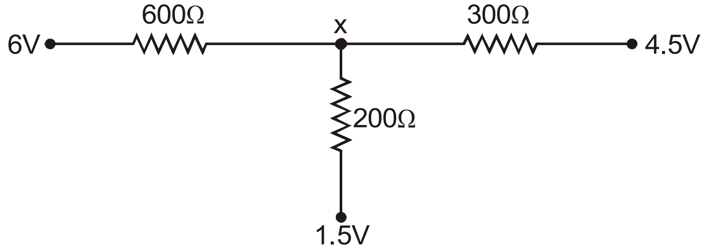
$I_2 = \frac{1}{2}A$

22. (B)

By symmetry, the p.d. across C_2 is 6V

$$\therefore \quad U_2 = \frac{1}{2} \times (10^{-6}) \times 36 = (18 \times 10^{-6})J$$

23. (A)



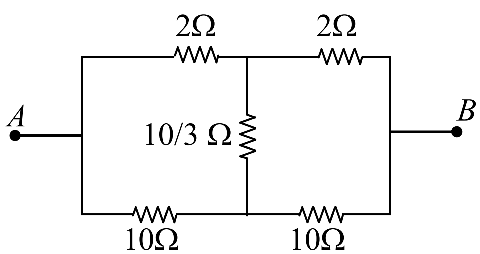
$$\frac{x-6}{600} + \frac{x-1.5}{200} + \frac{x-4.5}{300} = 0 \Rightarrow x = 3.25V$$

24. (C) **25. (D)** **26. (C)** **27. (A)**

28. (D)

$i_g(G+R) = V$, $10^{-3}(400+R) = 8$, R = 7600Ω

29. (A)



Equivalent ciruit is balanced Wheat- stone bridge as shown

$R_{AB} = \frac{10}{3}$ Ω.

30. (A)

$R_{Voltmeter}$ = 6Ω, $R_{ammeter}$ = 0.5Ω

R_{eq} = 10Ω

$$I = \frac{30}{10} = 3A$$

Reading of voltmeter = 1 × 3 = 3 volt.

CHEMISTRY

31. (A)

If P° is the vapour pressure of pure benzene and P the vapour pressure of solution, w the weight of non-volatile substance of molecular mass 'm' and W the weight of solvent benzene with molecular mass M,

$$\frac{P° - P}{P°} = \frac{w/m}{W/M} = \frac{wM}{Wm}$$ substituting the values

$$\frac{10}{750} = \frac{2 \times 78}{78 \times m}$$ Or m = 150

32. (B)

Mole fraction of solute X_2 = 0.2. Therefore, mole fraction of solvent X_1 = 0.8

Or $\frac{n_2}{n_1 + n_2} = 0.2$ and $\frac{n_1}{n_1 + n_2} = 0.8$

$$\therefore \quad \frac{n_2}{n_1} = \frac{0.2}{0.8} = \frac{1}{4}$$

Now, if n_1(solvent moles) = 1000/78 = 12.8 moles

n_2 = 12.8/4 = 3.2 moles. Therefore, 3.2 moles of the compound are present in one Kg of solvent benzene and so molality = 3.2.

33. (C)

For equimolar solutions, mole fraction of benzene = mole fraction of toluene

Or $x_B = x_T = 0.5$

Now, vapour pressure of benzene $P_B = x_B.P_B° = 0.5 \times 160 = 80$ mm

And, vapour pressure of toluene $P_T = x_T.P_T° = 0.5 \times 80 = 40$ mm

And, total vapour pressure = 80 + 40 = 120 mm

So, mole fraction of toluene in vapour phase = $\frac{30}{120} = \frac{1}{3}$

34. (C)

$\Delta T_b = K_b.m$

Or $m = \frac{\Delta T_b}{K_b} = \frac{0.01}{0.5}$ = 0.02 mole Kg^{-1} of water

So, the number of moles of glucose in 100 g of water

$= \frac{0.02 \times 100}{1000}$ = 0.002 moles of glucose = $0.002 \times 6.023 \times 10^{23} = 2 \times 6.023 \times 10^{20}$ molecules

35. (C)

$$2H_2O \longrightarrow 2H_{2(g)} + O_{2(g)}$$
$$\quad\quad\quad 2x \quad\quad x$$

$\therefore$ 3x = 0.168

$\therefore$ x = 0.056L

V_{H_2} = 2x = 0.112L, V_{O_2} = x = 0.056L

11.2L of H_2 at STP $\equiv$ 1F

0.112L of H_2 at STP $\equiv$ 0.01F

0.056L of O_2 at STP = 0.01F

$\therefore$ The amount of electricity passed = 0.01F = 965C

36. (D)

H^+ ion has the maximum λ_m^o which is explainable by Grothus mechanics, Li^+ having the maximum charge density, is the most hydrated ion among the lot and hence the lowest λ_m^o

37. (B)

$t_{1/2}$ for nth order reaction = $\dfrac{2^{n-1}-1}{(n-1)k(a)^{n-1}}$ On substituting n = 2, we obtain $t_{1/2} = \dfrac{2-1}{1.k.a} = \dfrac{1}{ka}$.

Therefore, the order of the reaction is 2.

So, unit of K = $M^{-1}s^{-1}$

38. (C)

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

or $t = \dfrac{2.303}{6}\log\dfrac{6\times0.5}{0.3} = \dfrac{2.303}{6}\log10 = \dfrac{2.303}{6} = 0.384$ min.

39. (B)

The required combustion equation is obtained as

2 × eqn. (3) $2S + 2O_2 \rightarrow 2SO_2$ 2 × (–297.0) KJ

+ eqn. (2) + $C + O_2 \rightarrow CO_2$ +(–393.0) KJ

–eqn. (1) $-C - 2S \rightarrow -CS_2$ –(+117.0) KJ

or we get $2S + 3O_2 - 2S \rightarrow 2SO_2 + CO_2 - CS_2$

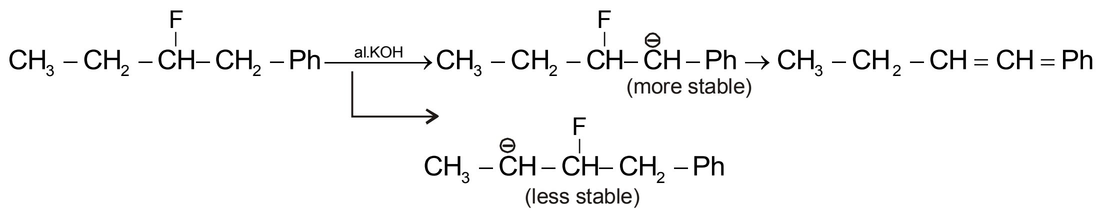
or $CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$ (–1104 KJ mol^{-1})

The answer is (B).

40. (B)

Isothermal expansion of an ideal gas does not change energy and, therefore, $\Delta U = 0$.

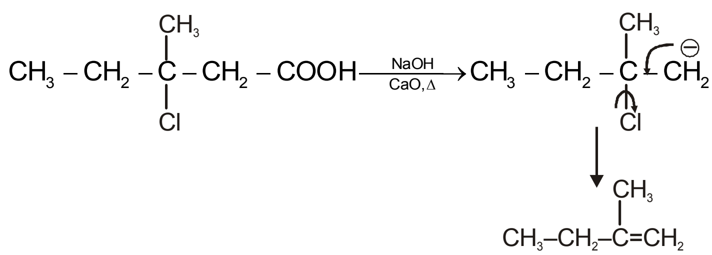
41. (B)



42. (C)

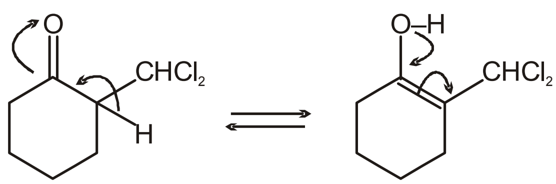
$$CH_3-CH=CH-COOH \xrightarrow[\text{CaO},\Delta]{\text{NaOH}} CH_3-CH=CH_2$$
(Decarboxylation)

43. (A)



44. (A)

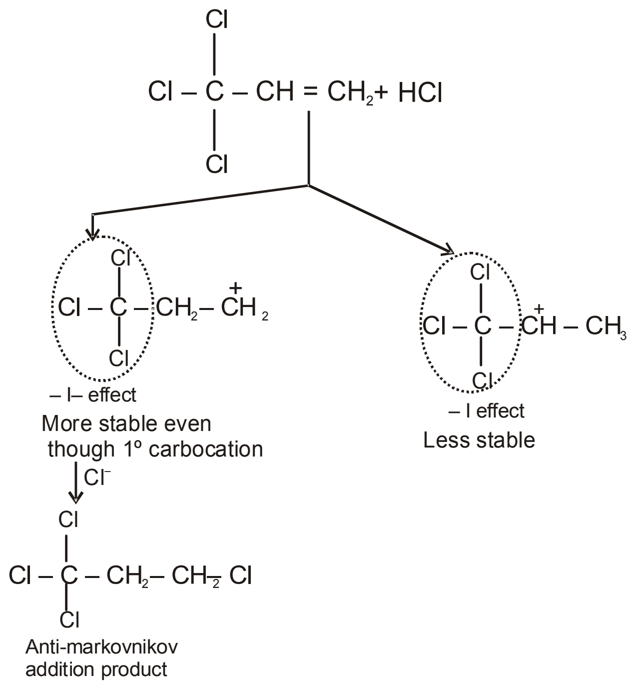
In most cases tautomerims involves interconversion of suitable constitutional isomers by the 1,3-shift of hydrogen from an atom which is it self bonded to a functional group containing a multiple bond. Tautomers differ in the location of the double bond and hydrogen.



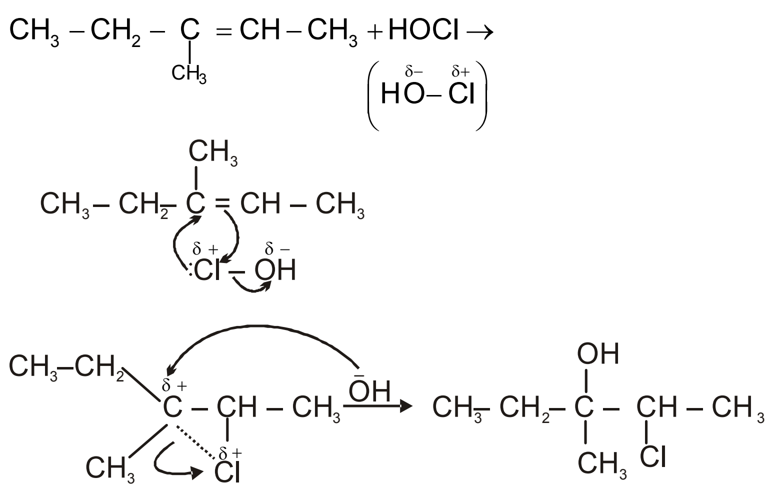
45. (A)

Both are indentical because both having same configuration on respective asymmetric centre

46. (B)



47. (C)

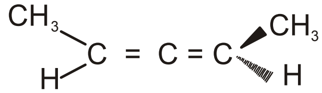


(Halohydrin)

48. (A)

$CH_3-CH=C=CH-CH_3$ (cumulenes with even no. of C = C bond)

Molecule possessing axial chirality



Chiral (optically active)

49. (B)

50. (A)

$H_3C - C \equiv CH$

51. (C)

52. (C)

53. (B)

Slag formed during extraction of copper is $FeSiO_3$.

54. (B)

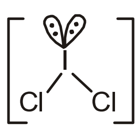
In the cyanide process involving extraction of silver, zinc is used industrially as reducing agent.

55. (B)

Strength of ligands α stability of complex.

$H_2O < NH_3 < NO_2^-$ is correct order of stability.

56. (D)



(Sp^3)

57. (C)

Large sized chlorine atom do not fit in between the small boron atom whereas small sized hydrogen

atom get fitted in between boron atom.

58. (B)

$H_3PO_4 < H_3PO_3 < H_3PO_2$ Acidic Nature

59. (D)

It act as dehydrating agent & absorption of water is highly exothermic.

60. (D)

$$\xrightarrow[\text{Oxidizing Nature}]{I < Br < Cl < F}$$

MATHEMATICS

61. (C)

[x] + [–x] = 0 $\quad x \in I$

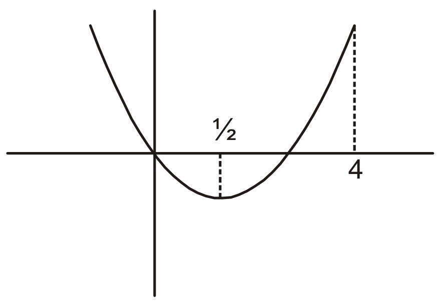
[x] + [–x] = –1 $\quad x \notin I$

62. (B)

$$\int \frac{(x+1)^2-(x-1)^2}{(x+1)^2(x-1)^2}dx \Rightarrow \int \frac{dx}{(x-1)^2} - \int \frac{dx}{(x+1)^2}$$

$$\Rightarrow -\frac{1}{x-1}+\frac{1}{x+1}+c \Rightarrow \frac{1}{x+1}-\frac{1}{x-1} = -\frac{2}{x^2-1}+c$$

63. (C)



$$\left|\int_{1/2}^{1}(x^2-x)dx\right| + \int_{1}^{4}(x^2-x)dx$$

$$\left|\left(\frac{x^3}{3}-\frac{x^2}{2}\right)_{1/2}^{1}\right| + \left(\frac{x^3}{3}-\frac{x^2}{2}\right)_{1}^{4} \Rightarrow \left|\left(\frac{1}{3}-\frac{1}{2}\right)-\left(\frac{1}{24}-\frac{1}{8}\right)\right| + \left[\left(\frac{64}{3}-8\right)-\left(\frac{1}{3}-\frac{1}{2}\right)\right]$$

$$\left|-\frac{1}{6}-\left(\frac{1-3}{24}\right)\right| + \left[\frac{40}{3}+\frac{1}{6}\right] = \frac{163}{12}$$

64. (A)

$$xdy - ydx = \sqrt{x^2-y^2}\ dx$$

$$d\left(\frac{y}{x}\right) = \frac{\sqrt{1-\left(\frac{y}{x}\right)^2}\ dx}{x}$$

$$\int \frac{d\left(\frac{y}{x}\right)}{\sqrt{1-\left(\frac{y}{x}\right)^2}} = \int \frac{dx}{x}$$

65. (B)

$$\frac{\sin\frac{4x}{2}\cdot\cos\left\{x+(4-1)\frac{x}{2}\right\}}{\sin\frac{x}{2}} = -\frac{1}{2}$$

$$2\sin 2x\cdot\cos\frac{5x}{2} = -\sin\frac{x}{2}$$

$$\sin\frac{9x}{2} + \sin\left(-\frac{x}{2}\right) = -\sin\frac{x}{2}$$

$$\frac{9x}{2} = n\pi \Rightarrow x = \frac{2n\pi}{9}$$

66. (B)

$$y = 4x + \sqrt{16a^2 + b^2}$$

$$8^2 = 16a^2 + b^2$$

$$\frac{16a^2 + b^2}{2} \ge \sqrt{16a^2b^2} \Rightarrow 32 \ge 4ab \Rightarrow (ab)max. = 8$$

67. (B)

$$(x-2)^2 + (y+3)^2 = 1^2$$

$$(x-5)^2 + (y+7)^2 = 2^2$$

$\therefore$ minimum distance = 5 – 3 = 2

68. (A)

$$y = (\sin x - 2)^2 + 1$$

69. (B)

6x + 8y + 10 = 0

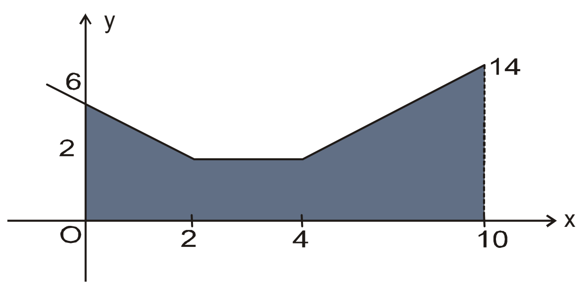
6x + 8y – 7 = 0

$$D = \frac{17}{10}$$

70. (A)

x = 1, 2 , |x – 2| = 1 or x = 2 ± 1 = 3, 1

71. (A)



$$10 \times 2 + \frac{1}{2} \times 2 \times 4 + \frac{1}{2} \times 6 \times 12 \Rightarrow 20 + 4 + 36 = 60$$

72. (A)

$$\left| \int_0^1 x \ln x \, dx \right| = \frac{1}{4}$$

73. (B)

$$x^2y^2 - x^2 - y^2 + 1 = 0$$

$$x = \pm 1,\ y = \pm 1$$

74. (B)

75. (A)

$$y = x^{\frac{1}{x}}$$

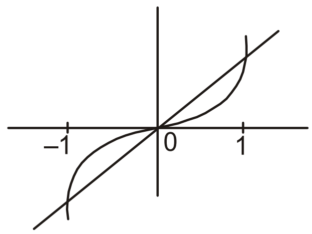
$$\ln y = \frac{1}{x} \ln x$$

$$\frac{1dy}{y\,dx} = \frac{x \cdot \frac{1}{x} - \ln x}{x^2} = 0 \Rightarrow x = e$$

76. (B)

$$f'(c) = \frac{f(3) - f(1)}{2} \Rightarrow 6c + 5 = 17 \Rightarrow c = 2$$

77. (B)



78. (B)

$$y - mx = \pm\sqrt{39m^2 - 14}$$

It passes through (3, 4) so, $30m^2 + 24m - 30 = 0$

$\Rightarrow m_1 m_2 = -1$

79. (A)

80. (B)

$S = 5 + 7 + 11 + 17 + 25 \text{ ....} + T_n$

$S = \quad 5 + 7 + 11 + 17 + \text{ ....} + T_{n-1} + T_n$

$$\Rightarrow T_n = n^2 - n + 5 \quad \therefore S = \sum_{n=1}^{n} T_n = \frac{n\left(n^2 + 14\right)}{3}$$

81. (B)

$z = x + i y$

$z^2 = x^2 - y^2 + 2xy\, i$

$2xy = 10$

$xy = 5$

82. (B)

$$\frac{dy}{dx} = e^x \cdot e^y$$

$$\int \frac{dy}{e^y} = \int e^x\, dx \Rightarrow -e^{-y} = e^x + c$$

83. (A)

$$y = e^{kx}$$

$$kx = \ln y$$

$$k = \frac{\ln y}{x}$$

$$\frac{x.\frac{1}{y}\frac{dy}{dx} - \ln y \cdot 1}{x^2} = 0$$

$$\frac{x}{y}\left(-\frac{dx}{dy}\right) = \ln y$$

On solving we get, $\frac{y^2}{2} - x^2 = y^2 \ln y + c$

84. (C)

85. (A)

86. (C)

Point of intersection (0, 0) & (–1, –1)

87. (C)

$$\int_0^5 [x]\, dx + \int_5^{5.6} [x]\, dx$$

$0 + 1 + 2 + 3 + 4 + 5 \times 0.6 = 10 + 3 = 13$

88. (B)

Suppose n(A) = n, then number of reflexive relations on A is $= 2^{n^2 - n}$

and number of symmetric relations on A is $= 2^{\frac{n^2+n}{2}} \Rightarrow n^2 - 3n = 0 \Rightarrow n = 3$.

89. (B)

As f(x) is an odd cubic polynomial function. So, it must be of the form $f(x) = ax^3 + bx$

Now, $\lim_{x \to 0} \left(\frac{f(x)}{x} + 1 \right)^{\frac{1}{x^2}}$ exists if $\lim_{x \to 0} \frac{f(x)}{x} = 0 \Rightarrow b = 0$

$$\lim_{x \to 0} \left(\frac{f(x)}{x} + 1 \right)^{\frac{1}{x^2}} = e^2 \Rightarrow e^a = e^2 \Rightarrow a = 2 \Rightarrow f(x) = 2x^3$$

$$h(x) = e^{x+1} \int_1^x e^{-t} f(t)\, dt \Rightarrow h'(x) = e\, f(x) + e^{x+1} \int_1^x e^{-t} f(t)\, dt \qquad \therefore h'(1) = e\, f(1) = 2e$$

90. (D)

$$F(x) = \begin{vmatrix} f(x) & f\left(\frac{x}{3}\right) \\ g(x) & g\left(\frac{x}{2}\right) \end{vmatrix} = f(x) \cdot g(x/2) - g(x) \cdot f(x/3)$$

Period of f(x) is 3

$\therefore$ Period of f(x/3) is 9

Period of g(x) is 2

$\therefore$ Period of g(x/2) is 4

$\therefore$ Period of F(x) is L.C.M. of period of $f(x) \cdot g(x/2) - g(x) \cdot f(x/3) = 36$